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Adam K Stanley * [1], Ashton Barnett-Vanes [1,2], Matthew J Reed [1,2]

[1] College of Medicine and Veterinary Medicine, University of Edinburgh,

The Chancellor's Building, 49 Little France Crescent Edinburgh EH16 4SB, UK.

[2] Emergency Medicine Research Group Edinburgh (EMERGE),

Department of Emergency Medicine, Royal Infirmary of Edinburgh,

51 Little France Crescent, Edinburgh, EH16 4SA, UK.

*** Corresponding Author**

Address for correspondence:

Adam Stanley

College of Medicine and Veterinary Medicine

49 Little France Crescent

Edinburgh, EH16 4SB

Tel: 07568534509

E-mail address: adam.stanleyk@gmail.com

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All patient data were anonymised prior to release from the NHS.

The study was deemed by the South East Scotland Regional Ethics Committee to be a service evaluation survey and did not therefore require formal ethical approval.

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Over a billion peripheral intravenous cannulas (PIVC) are used globally every year with at least 25 million sold annually in the UK.[1,2] The NHS spends an estimated £29m of its annual acute sector budget on PIVC procurement[3] and around 70% of all hospitalised patients require at least one PIVC during their stay.[4] Despite their extensive and routine use, PIVC failure rates are reported as high as 50-69%.[5-7] In addition, many PIVCs remain unused following insertion, particularly in the Emergency Department (ED).[8,9] The risk factors for PIVC failure are not well understood and the literature has found extensive regional variation in practice when it comes to PIVC insertion and management.[1,7,10] While various technologies have been developed to address these issues, there remains a need for standardised, evidence-based guidelines.

We conducted a semi-structured healthcare questionnaire survey in the Royal Infirmary of Edinburgh ED which aimed to evaluate the failure rate of PIVCs inserted pre-hospital and in the ED and identify factors associated with failure. Failure was defined as loss of PIVC function due to extravasation, phlebitis or occlusion. Cannula, patient, inserter and location data were collected over a 6-week period. It was also noted whether each PIVC had been documented on the Electronic Patient Record (EPR) system, which contains a questionnaire template to be completed following PIVC insertion. Patients were followed up daily for the duration of their hospital stay. In the event of cannula removal, the reason was recorded in addition to the duration of PIVC survival. Data collection was carried out on weekdays between the hours of 8am to 6pm. Patients were approached by (AS) and invited to enrol in the study, after which data was captured in a standardised manner using a data and questionnaire sheet (see appendix). All patients were assigned anonymous identification numbers stored on a password protected drive and all patient data was anonymised prior to NHS release. This service evaluation survey was deemed by the South East Scotland Research Ethics Service (SESRES) not to require formal ethics review and was registered with the Edinburgh Quality Improvement Projects in the ED (eQuIPED) registry. Pearson's Chi-squared test was used to

compare factors associated with PIVC failure and log-rank tests to compare factors associated with PIVC survival. Statistical analysis was conducted using IBM SPSS® Statistics version 24.0.

Data were collected on a convenience sample of 104 patients with 119 PIVCs between 27.01.20 and 06.03.20. 90 PIVCs (75.6%) were inserted in the ED and 29 (24.4%) were inserted pre-hospital. Nurses inserted the largest proportion of PIVCs (n=49, 41.2%), followed by doctors (n=35, 29.4%), paramedics (n=29, 24.4%), physician associates (n=4, 3.4%) and medical students (n=2, 1.7%). The antecubital fossa was the most common insertion site (n=62, 52.1%) followed by the posterior hand (n=27, 22.7%), wrist (n=15, 12.6%), forearm (n=13, 10.9%), upper arm (n=1, 0.8%) and finger (n=1, 0.8%). 61 PIVCs (51.3%) were inserted in the non-dominant arm, with 58 (48.7%) in the dominant arm. Preferred PIVC gauge was 20G (n=78, 65.5%), followed by 18G (n=28, 23.5%), 22G (n=9, 7.6%) and 16G (n=4, 3.4%). Only 26 PIVCs (21.8%) were documented on the EPR system.

33 PIVCs (27.7%) failed, with 15 (12.6%) routinely removed or no longer required and 13 (10.9%) removed for undefined reasons. In patients admitted, 29 PIVCs (42.6%) failed, with 15 (22.1%) removed routinely and 11 (16.2%) undefined. PIVC failure was associated with dominant arm insertion ($p=0.011$) and pre-hospital insertion ($p=0.001$). Log-rank tests revealed that cumulative PIVC survival was lower in dominant arm ($p=0.01$) and pre-hospital insertions ($p<0.001$). Kaplan-Meier curves are shown in the Figure.

In conclusion, we found a high PIVC failure rate (43%) in admitted patients. Dominant arm and pre-hospital insertion were significantly associated with PIVC failure and this is consistent with previous research.[6] Based on these results, we would suggest that dominant arm insertion should be avoided where possible. Pre-hospital insertion should only be undertaken if deemed necessary rather than routine, whilst acknowledging that patients are often undifferentiated and at high risk of deterioration, meaning a lower threshold for PIVC insertion is not unreasonably common practice. While guidance suggests that PIVCs should last at least 3 to 4 days if clean and not infected, our results show earlier drops in PIVC survival. The

largest drop was observed on day 2, by which time patients had all been transferred to the Acute Medical Unit and/or downstream wards. Further research is needed to investigate PIVC management on the wards and the effects of patient transfer on PIVC survival. PIVC failure was not significantly associated with admission to any specific downstream wards. However, we were unable to determine whether specific pathologies amongst patients contributed towards PIVC failure. Therefore, further research investigating the relationship between disease and PIVC survival would be useful. Overall, our findings highlight the prominence of PIVC failure and together with other published research can begin to inform the development of standardised guidelines, essential to control the extensive variation in practice and high PIVC failure rates.

Figure 1:

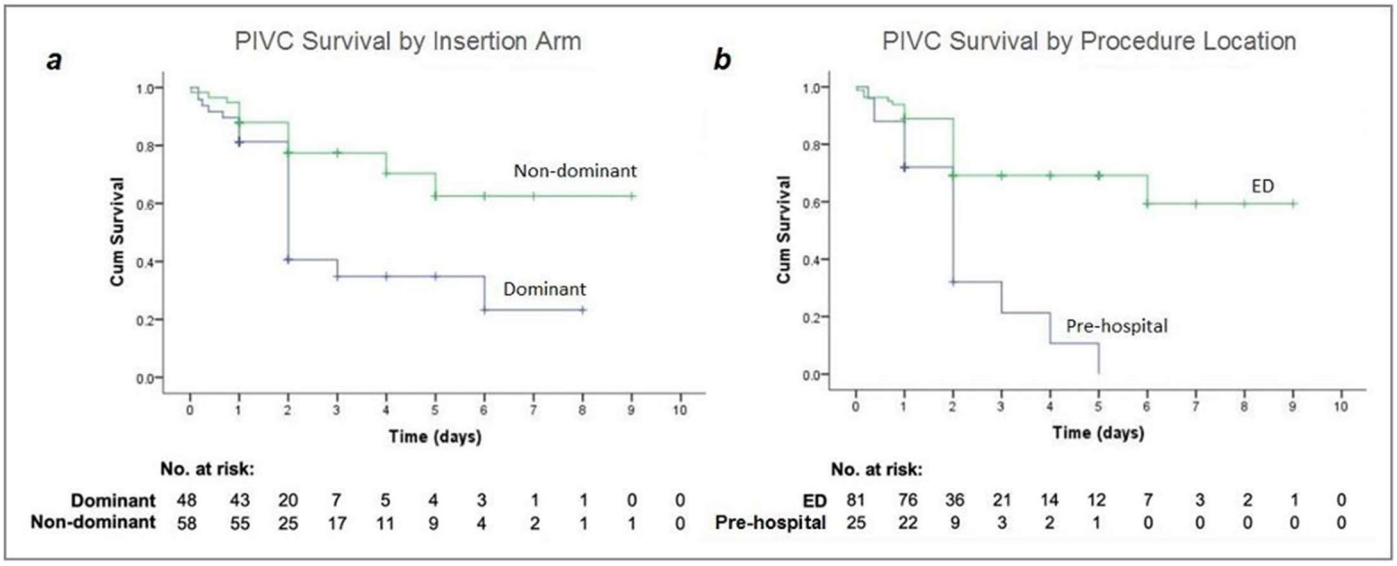

Figure Legend: PIVC Kaplan-Meier survival curves by insertion arm (a) and procedure location (b).

References

1. Alexandrou E, Ray-Barruel G, Carr PJ, Frost S, Inwood S, Higgins N, et al. International prevalence of the use of peripheral intravenous catheters, J Hosp Med. 2015 Aug;10(8):530-3

2. NHS Clinical Evaluation Team. Clinical review: safety peripheral intravenous cannula. 2018.

3. Guerrero MA. National evaluation of safety peripheral intravenous catheters in a clinician-led project. Br J Nurs. 2019 Jan 24;28(2):S29-32.

4. Webster J, Clarke S, Paterson D, Hutton A, Dyk S, Gale C et al. Routine care of peripheral intravenous catheters versus clinically indicated replacement: randomised controlled trial. BMJ. 2008;337(jul08 1):a339-a339.

5. Helm RE, Klausner JD, Klemperer JD, Flint LM, Huang E. Accepted but Unacceptable. J Infus Nurs. 2015;38(3):189-203.

6. Marsh N, Webster J, Larsen E, Cooke M, Mihala G, Rickard CM. Observational Study of Peripheral Intravenous Catheter Outcomes in Adult Hospitalized Patients: A Multivariable Analysis of Peripheral Intravenous Catheter Failure. J Hosp Med. 2017 Oct 18.

7. Alexandrou E, Ray-Barruel G, Carr PJ, Frost SA, Inwood S, Higgins N, et al. Use of Short Peripheral Intravenous Catheters: Characteristics, Management, and Outcomes Worldwide. J Hosp Med. 2018 May 30;13(5).

8. Limm EI, Fang X, Dendle C, Stuart RL, Egerton Warburton D. Half of All Peripheral Intravenous Lines in an Australian Tertiary Emergency Department Are Unused: Pain With No Gain? Ann Emerg Med. 2013 Nov;62(5):521-5.

9. Gledstone-Brown L, McHugh D. Review article: Idle 'just-in-case' peripheral intravenous cannulas in the emergency department: Is something wrong? Emerg Med Australas. 2018 Jun;30(3):309-26.

10. Webster J, Osborne S, Rickard C, Marsh N. Clinically-indicated replacement versus routine replacement of peripheral venous catheters. Cochrane Database of Systematic Reviews. 2019.

Appendix: Data and questionnaire sheet

PIVC Usage in the ED – Case Report Form

Anonymous Patient ID: Date:

Patient Characteristics **(from TRAK)**	
Gender	
Age	
BMI	

Initial cannulation

Number of attempts / Time	Free text:
Gauge of cannula	14 (orange) ☐ 16 (grey) ☐ 18 (green) ☐ 20 (pink) ☐ 22 (blue) ☐
Insertion site	Ant. upper arm (medial) ☐ Ant. upper arm (lateral) ☐ Antecubital fossa ☐ Ant. forearm (medial) ☐ Ant. forearm (lateral) ☐ Post. forearm ☐ Ant. wrist ☐ Dorsum wrist ☐ Post. hand ☐ Lateral wrist (houseman's) ☐ Groin ☐ Lower leg / foot ☐ Neck ☐
US guidance	Yes ☐ No ☐
Arm	Dominant ☐ Non-dominant ☐
Inserted by	Paramedic ☐ Nurse ☐ Adv. nurse practitioner ☐ Medical student ☐ Foundation doctor ☐ Physician Associate ☐ ST1-3 ☐ ST4-8 ☐ Consultant ☐
Location	Ambulance ☐ ED ☐

Follow-up

Removal: Reason: Number of replacements:	Routine ☐ Failure ☐ Undefined ☐ Free text: _____
Admission type: Department:	Medicine ☐ Surgery ☐ Critical care ☐ Specialties ☐ Free text: _____

Final LoS (days): Reason for discharge: